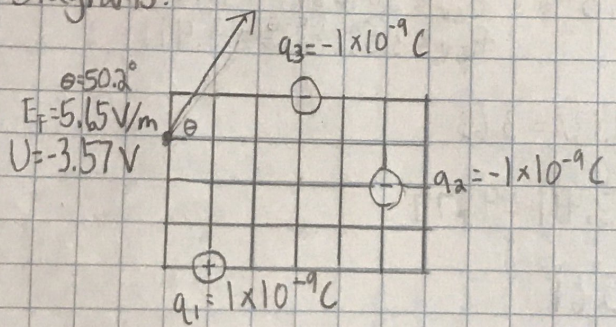
Lab 1: Electric fields

Introduction:
This lab is used to explore an electric field and electric potential simulation that gives us a better understanding of how the electric fields work. The simulation allows exploration through placement of different charges and sensors that show the magnitude and direction of the electric field. The purpose of the lab is to find values for electric field and potential, and compare it to calculated values to check the accuracy.

Diagrams:

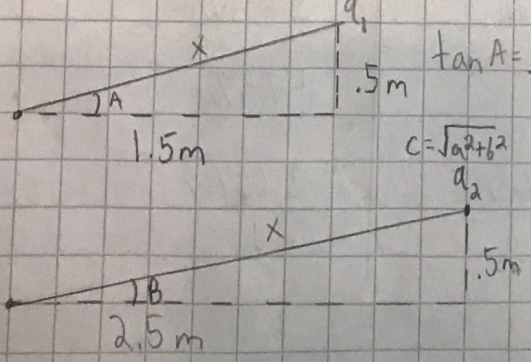


Equations:

$E_F = \frac{kq}{r^2}$ $V = \frac{kq}{r}$ $c^2 = a^2 + b^2$

$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$ $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

Calculations:

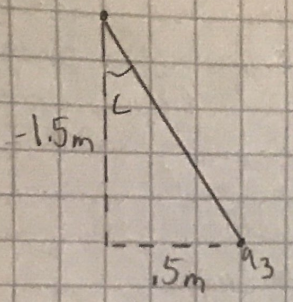


$\tan A = \frac{o}{a}$ $A = \tan^{-1}\left(\frac{.5}{1.5}\right) = 18.435°$

$c = \sqrt{a^2+b^2}$ $c = \sqrt{(1.5)^2+(.5)^2} = 1.5811$

$B = \tan^{-1}\left(\frac{.5}{2.5}\right) = 11.310°$

$c = \sqrt{(2.5)^2+(.5)^2} = 2.5495$



$$c = \tan^{-1}\left(\frac{.5}{1.5}\right) = 18.435°$$

$$c = \sqrt{(1.5)^2 + (.5)^2} = 1.5811$$

$$E_A = \frac{kq}{r^2} = \frac{(8.99\times10^9)(1\times10^{-9})}{(1.5811)^2} = 3.596 \qquad E_{AX} = 3.596\cos\theta = 3.411 \quad E_{AY} = 3.596\sin\theta = 1.137$$

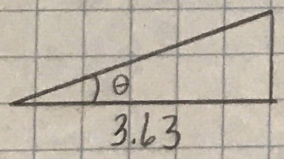
$$E_B = \frac{(8.99\times10^9)(1\times10^{-9})}{(2.5495)^2} = 1.383 \qquad E_{BX} = 1.383\cos\theta = 1.356 \quad E_{BY} = 1.383\sin\theta = .2712$$

$$E_C = \frac{(8.99\times10^9)(1\times10^{-9})}{(1.5811)^2} = 3.596 \qquad E_{CX} = 3.596\sin\theta = 1.137 \quad E_{CY} = 3.596\cos\theta = 3.411$$

$$E_X = E_{AX} + E_{BX} + E_{CX} = 3.411 + 1.356 - 1.137 = 3.63$$

$$E_Y = E_{AY} + E_{BY} + E_{CY} = 1.137 + .2712 + 3.411 = 4.277$$

$$E = \sqrt{E_x^2 + E_y^2} = \sqrt{(3.63)^2 + (4.277)^2} = 5.61$$



$$\theta = \tan^{-1}\left(\frac{4.277}{3.63}\right) = 49.7°$$

$$V = \frac{kq_1}{r_1} + \frac{kq_2}{r_2} + \frac{kq_3}{r_3} = \frac{(8.99\times10^9)(1\times10^{-9})}{1.5811} + \frac{(8.99\times10^9)(-1\times10^{-9})}{2.5495} + \frac{(8.99\times10^9)(-1\times10^{-9})}{1.5811} = -3.526$$

	Calculations	Simulation
Electric Field Magnitude	5.61 V/m	5.65 V/m
Direction	49.7°	47.9%
Electric Potential	-3.526 V	-3.667 V

Analysis:
The two sets of numbers are quite similar to each other. That is because the calculations were done correctly. However, some small differences exist between the two sets. The differences range from 1.8 units to .04 units. They are due to rounding with some numbers and are not significant enough to drastically change the answers.